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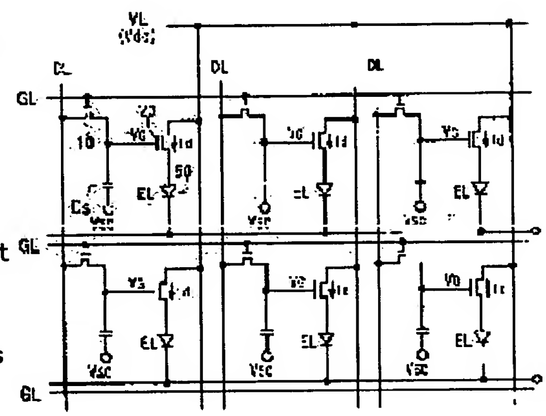
(54) DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To control power consumption in a display device having current- driven elements such as electroluminescence.

SOLUTION: In this display device, a current control circuit 300 is provided between a power source circuit 200 and a power source line VL supplying driving currents to organo-EL (electroluminescent) elements 50 provided in respective light emitting pixels of a display panel and the amount of a current flowing from the power source circuit 200 into the power source line VL is detected and when the amount of the current is increased, a power source voltage Vdd to be applied to the line VL is lowered and, as a result, currents made to flow through the organo-EL elements 50 are reduced. Or, contrasts and luminance levels of display data to be supplied to respective EL elements 50 are controlled in accordance with the detected amount of the current and when the amount of the current is increased, the currents made to flow through the organo-EL elements 50 are controlled by lowering the contrasts and luminance levels of the display data. By these methods, the amount of currents made to flow through the organo-EL elements 50 is controlled and the power consumption of the display device can be controlled so as not becomes excessively large.



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CLAIMS

[Claim(s)]

[Claim 1] Display characterized by providing the following. The display in which two or more pixels equipped with the current drive type light emitting device constituted in preparation for between an anode plate and cathode at least in a luminous layer were prepared. The current control section which controls the amount of current which it is prepared between the power supply section which generates the power supply for making each current drive type light emitting device of the aforementioned display emit light, and each current drive type light emitting device of the aforementioned power supply section and the aforementioned display, and is passed to each current drive type light emitting device according to the amount of current from the aforementioned power supply section.

[Claim 2] It is the display characterized by decreasing the amount of current which the supply voltage which will be supplied to each aforementioned current drive type light emitting device if the aforementioned amount of current increases the aforementioned current control section in display according to claim 1 is reduced, and flows to this current drive type light emitting device.

[Claim 3] It is the display characterized by controlling the contrast or the intensity level of an indicative data which supplies the aforementioned current control section to each current drive type light emitting device in display according to claim 1 or 2.

[Claim 4] It is the display characterized by reducing the contrast or the intensity level of the aforementioned indicative data if the aforementioned amount of current increases the aforementioned current control section in display according to claim 3.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the display equipped with current drive type light emitting devices, such as an organic electroluminescence (below Electroluminescence: EL) element.
[0002]
[Description of the Prior Art] It is observed as display which there are advantageous points, like its power consumption is thinly small while EL display is a spontaneous light type at each pixel, and replaces the EL element which is a current drive type light emitting device with display, such as a liquid crystal display (LCD) and CRT, and research is advanced.
[0003] Moreover, switching devices, such as TFT (TFT) which controls an EL element individually, are prepared in each pixel especially, and the active-matrix type EL display which controls an EL element for every pixel is expected as high definition display.
[0004] Drawing 7 shows the circuitry per pixel in the active-matrix type EL display of a m line n train. In EL display, two or more gate lines GL were prolonged on the substrate at the line writing direction, and two or more data lines DL and power supply lines VL are prolonged in the direction of a train in it. And near the field surrounded with the data line DL, and the power supply line VL and the gate line GL serves as a field by 1 pixel, and organic EL element 50, TFT10 for switching (the 1st TFT) and TFT20 for an EL-element drive (the 2nd TFT), and retention volume Cs are formed in this 1-pixel field.
[0005] It connects with the gate line GL and the data line DL, and 1st TFT10 is turned on in response to a gate signal (selection signal) in a gate electrode. The data signal currently supplied to the data line DL at this time is held at the retention volume Cs connected between 1st TFT10 and 2nd TFT20. The voltage according to the data signal held with the retention volume Cs supplied through the 1st above TFT 10 is impressed to the gate electrode of 2nd TFT20, and 2nd TFT20 supplies the current according to the gate voltage to organic EL element 50 from the power supply line VL. An organic EL element emits light by the luminescence brightness according to the data signal for every pixel, and a desired image is displayed by such operation.
[0006]
[Problem(s) to be Solved by the Invention] Each EL element of organic EL display is a current drive type light emitting device which flows between anode plate-cathode and which carries out current ****** luminescence, and the whole consumed electric current increases, so that the power consumption as a panel is changed and the point emitting light increases with the number of the elements which emit light on a panel.
[0007] However, while the electronic equipment by which it is called for strongly that they are low powers, such as a display of a cellular phone, increases, in order to use organic EL display as a display of such a device, control of the power consumption, especially suppression of maximum electric power consumption are needed. Moreover, since an organic EL element generates heat by current drive, even if the voltage in the power supply line VL is fixed, it is also considered that the current value which flows to an organic EL element increases, and it may produce still more unnecessary power consumption. Therefore, it is **** rare ** to control the amount of current which flows for an element also from such a viewpoint.
[0008] this invention is made in view of the above-mentioned technical problem, and aims at enabling suppression of the maximum electric power consumption of display, such as an EL panel.
[0009]
[Means for Solving the Problem] The display in which two or more pixels equipped with the current drive type light emitting device constituted in preparation for between an anode plate and cathode at least in display in a

luminous layer, as for this invention were prepared in order to attain the above-mentioned purpose, The power supply section which generates the power supply for making each current drive type light emitting device of the aforementioned display emit light, It is prepared between each current drive type light emitting device of the aforementioned power supply section and the aforementioned display, and is characterized by having the current control section which controls the amount of current passed to each current drive type light emitting device according to the amount of current from the aforementioned power supply section.
[0010] The current which flows from a power supply to a display increases, so that there are many pixels which current drive type light emitting devices, such as electroluminescent element, emit light in proportion to supply current, and emit light by the display, and equipment power consumption increases. Since the amount of current passed to each current drive type light emitting device according to the amount of current which flows toward a display from this power supply is controlled by this invention, even if there are many light emitting devices, the current which flows for each element is controlled in the range suitable as the whole display, and maximum electric power consumption is suppressed.
[0011] Other features of this invention are that the above-mentioned current control section decreases the amount of current which the supply voltage which will be impressed to each aforementioned current drive type light emitting device if the aforementioned amount of current increases is reduced, and flows to each aforementioned current drive type light emitting device. If the voltage of the power supply impressed to an element is reduced by such control, the current which flows for this element can be decreased easily and certainly.
[0012] Moreover, other features of this invention are controlling the contrast or the intensity level of an indicative data which in addition to the above-mentioned control is different from the above-mentioned control and a control section's supplies to each current drive type light emitting device.
[0013] Furthermore, other features of this invention are that a control section reduces the contrast or the intensity level of the aforementioned indicative data when the aforementioned amount of current increases.
[0014] Since the current according to the indicative data flowed and emitted light by each current drive type light emitting device, when the current supplied to a display from a power supply section increases, by reducing the contrast and the intensity level of an indicative data, the amount of current which flows for each element can be reduced, and the power consumption in a display can be suppressed certainly.
[0015]
[Embodiments of the Invention] Hereafter, the gestalt (henceforth an operation gestalt) of suitable implementation of this invention is explained using a drawing.
[0016] Drawing 1 shows the display circuitry of the active-matrix type EL display of the m line n train concerning the operation gestalt of this invention, and is the same as that of above-mentioned drawing 7 fundamentally. Each pixel prepared in a display is constituted near the field surrounded with the gate line GL prolonged in a line writing direction, and the data line DL and the power supply line VL which are prolonged in the direction of a train, and is equipped with organic EL element 50, TFT10 for switching (the 1st TFT), TFT20 for an element drive (the 2nd TFT), and retention volume Cs. [two or more] 1st TFT10 is turned on in response to a gate signal to the gate, and the data signal from a data line DL is held at the retention volume Cs connected with 1st TFT10 and 2nd TFT20 in between. 2nd TFT20 is formed between the power supply line VL and organic EL element 50 (element anode plate), and supplies the current according to the voltage value of the data signal impressed to the gate from the power supply line VL to organic EL element 50.
[0017] Drawing 2 shows an example of the cross-section structure of organic EL element 50 and 2nd TFT20. With this operation gestalt, it reaches 2nd TFT20, and all of 1st TFT10 are bottom gate type TFT, and use for the active layer the polycrystal silicon layer which polycrystal-ized and was obtained by laser annealing etc., respectively (however, ****** 1TFT10 ellipsis). the [the 1st and] -- 2TFT 10 and 20 -- a wrap -- like, all over the substrate, the flattening insulating layer 18 for upper surface flattening is formed, and organic EL element 50 is formed in the upper layer Between an anode plate (the 1st electrode : transparent electrode) 51 and the cathode (the 2nd electrode : metal electrode) 55 which was common to each pixel and was formed in the best layer, the laminating of the organic layer is carried out and organic EL element 50 is constituted. The anode plate 51 is connected with the source field of 2nd TFT20 through the contact hole formed so that the flattening insulating layer 18 and the layer insulation film 14 might be penetrated. Moreover, as for the organic layer, the laminating of the hole transporting bed 52 (the 1st hole transporting bed, the 2nd hole transporting bed), the organic luminous layer 53, and the electronic transporting bed 54 is carried out, for example to order from the anode plate side.

[0018] With this operation gestalt, the anode plate 51 and the organic luminous layer 53 which organic EL element 50 becomes from ITO (Indium Tin Oxide) etc. are formed independently for every pixel, and the hole transporting beds 52 and the electronic transporting beds 54 other than these are common to each pixel, and they are formed. As an example, TPD (N, N'-diphenyl-N, N'-di(3-methylphenyl)-1, 1'-biphenyl-4, 4'-diamine) can be used for MTDATA (4, 4', 4"-tris(3-methylphenylphenylamino) triphenylamine) and the 2nd hole transporting bed by the 1st hole transporting bed. Although the organic luminous layer 53 changes for every pixel with luminescent color made into the purpose of R, G, and B, it contains BeBq2 (bis(10-hydroxybenzo[h] quinolinato) beryllium) containing a Quinacridone (Quinacridone) derivative, for example. BeBq2 can be used for the electronic transporting bed 54.

[0019] Drawing 3 shows the outline composition of the whole electroluminescence display concerning this operation gestalt. This display is equipped with the display panel 100, the power circuit 200, the current control circuit 300, and the display controller 500 of circuitry of drawing 1 . A power circuit 200 creates the drive current supplied to organic EL element 50. The current control circuit 300 controls the amount of current passed to each organic EL element 50 according to the amount of current which is prepared between a power circuit 200 and the power supply line VL of a display panel 100, and flows toward the power supply line VL from a power circuit 200 so that it may mention later. The display controller 500 has the video signal processing circuit 510, the synchronizing separation processing circuit 520, and timing controller (traveler's check) circuit 530 grade. The video signal processing section 510 processes a video input, and supplies R, G, and B-display data to organic EL panel 100, and the synchronizing separation processing circuit 520 separates a vertical synchronizing signal Vsync and a horizontal synchronizing signal Hsync from a video input. The traveler's check circuit 530 creates the timing signal for driving each pixel of a display panel 100 for a perpendicular, the level start pulse S and a perpendicular, a level clock, etc. based on the vertical synchronizing signal Vsync and horizontal synchronizing signal Hsync from the synchronizing separation processing circuit 520.

[0020] Next, the current control circuit 300 is explained. A voltage drop element, an inductance element, etc. can be used for the current control circuit 300, for example, resistance can constitute it. If it is common within a panel 100 as shown in drawing 1 , and the element number which emits light increases, the amount of current of the power supply line VL which supplies power to each EL element 50 which flows on the power supply line VL from a power circuit 200 will also increase. The resistance as a current control circuit 300 is prepared into the path to the power supply line VL from the power circuit 200 so that it may be this operation gestalt, and the voltage drop (RI) according to the amount of current (I) which flowed to resistance (R) here occurs. And only "PVdd-RI" becomes low to the supply voltage PVdd in which the power circuit 200 generated the supply voltage Vdd by which the part voltage drop will be impressed to the power supply line VL by becoming large if the amount of current which flows to resistance increases. As mentioned above, in each pixel, the anode plate of organic EL element 50 is connected to the power supply line VL through the source drain of 2nd TFT20, and if the voltage of the power supply line VL falls, the current which flows to the anode plate of organic EL element 50 through 2nd TFT20 according to this will decrease. Therefore, when the amount of current between a power circuit 200 and the power supply line VL increases, the current which flows to each organic EL element 50 can be decreased by lowering the supply voltage Vdd supplied to the power supply line VL by resistance as a current circuit 300. Thus, the amount of current in each organic EL element 50 can be controlled by controlling supply voltage Vdd according to the amount of current which flows on the power supply line VL from a power circuit 200, and the power consumption as the whole display can be restricted by it.

[0021] Drawing 4 shows other examples of composition of the above-mentioned current control circuit 300. A control signal is generated according to the amount of current which flows toward the power supply line VL from a power circuit 200, and the contrast or the intensity level of a video signal which this supplies to each organic EL element 50 is controlled by this current control circuit 300. Moreover, control of supply voltage Vdd is also performed simultaneously.

[0022] In drawing 4 , the resistance 310 it is [resistance] a voltage drop element like [a circuit 300] the above between a power circuit 200 and the power supply line VL is formed, and supply voltage Vdd is lowered by the voltage drop according to the amount of current between a power circuit 200 and the power supply line VL. Moreover, in addition to the above-mentioned resistance 310, the current control circuit 300 is equipped with the control signal generating section 320 which creates the control signal according to the voltage between terminals of resistance 310. The video signal processing circuit 510 of the display controller 500 is supplied, and the video signal processing circuit 510 controls the contrast or the intensity level of a video signal according to this control

signal so that a dotted line shows the control signal created in the control signal generating section 320 to drawing 3 .

[0023] The control signal generating section 320 is equipped with the 1st amplifier 322,324, the 2nd amplifier (subtractor circuit) 326, the 3rd amplifier 328, and the 4th amplifier (buffer) 330 in the example of drawing 4 . The right input of the 1st amplifier 322,324 is connected to the power supply line side edge of resistance 310, and the power circuit side edge, respectively. High impedance conversion of each terminal voltage of resistance 310 is carried out with the 1st amplifier 322,324, and it is impressed to the negative input of a subtractor circuit 326, and a right input through resistance, respectively. The absolute value of the case where the voltage between terminals in resistance 310, i.e., a voltage drop, is large, and the output voltage (difference output) from a subtractor circuit 326 becomes large. In the circuitry of drawing 4 , the subtractor circuit 326 is carrying out reversal amplification of the voltage between terminals, and the 3rd amplifier 328 inverts this difference partial output by which reversal amplification was carried out, and it outputs it to the 4th amplifier 330. The 4th amplifier 330 carries out impedance conversion of the signal from the 3rd amplifier 328, and supplies it to a control terminal as a control signal. The control signal which is created as mentioned above and outputted from a control terminal turns into a voltage signal according to the amount of current which flows on the power supply line VL from the voltage drop 200 in resistance 310, i.e., a power circuit.

[0024] Drawing 5 explains how the video signal processing circuit 510 controls the contrast of an indicative data based on the above-mentioned control signal. In drawing 5 , the solid line simplifies and shows the indicative data formed in a normal state, the minimum level of this indicative data is equivalent to the maximum intensity level (white) in EL element 50, and the maximum level means the minimum intensity level (black).

[0025] Organic EL element 50 passes the current according to the amplitude of such a video signal (indicative data), and emits light. Therefore, in order to reduce the contrast of an indicative data, the video signal processing circuit 510 raises the minimum level of a status signal according to a control signal, contracts the difference of the maximum intensity level and the minimum intensity level, and it compresses an indicative-data amplitude almost equally so that an indicative-data amplitude is settled between this new minimum level and the maximum level so that a drawing middle point line shows. In case compression of such an amplitude carries out analogue conversion of the gradation data contained for example, in a digital video signal, it can realize the voltage step per one gradation by usually making it smaller than the time.

[0026] According to the control signal (voltage level) from the current control circuit 300, the elevation degree of the minimum level (white level) of a status signal is determined in this way, and the amount of current which flows to each organic EL element a gone up part of the minimum level of an indicative data decreases by supplying an organic EL element. Since the power consumption in an organic EL element will become so small if the amount of current which flows for an element becomes small, it can restrict the power consumption in an organic EL element by such control. Moreover, in contrast fall processing, in order to narrow the amplitude of an indicative data uniformly, the repeatability of an indicative data (especially gradation) is not spoiled and the reappearance capacity of an indicative data does not usually change with the time. Therefore, the power consumption of display can be restricted, without reducing the reappearance capacity of data by such contrast control.

[0027] Drawing 6 shows notionally how to control the intensity level of an indicative data based on a control signal. In drawing 6 , a solid line is the simple wave of the indicative data formed in a normal state like above-mentioned drawing 5 . When controlling an intensity level, the video signal processing section 510 raises the brightness minimum level of drawing 6 according to the control signal from the current control circuit 300, as one-point **** shows. Thus, raising the minimum intensity level makes the maximum brightness (white) level fall, when it sees about element luminescence brightness. The white-level display (slash portion of drawing) which will be less than this alternate long and short dash line by this if it is usually at the time is restricted to the white-level display of the alternate long and short dash line newly set up according to the voltage level of a control signal. In case such brightness limit processing carries out analogue conversion of the digital brightness data contained for example, in a digital video signal, it can be realized by processing of considering all as setting level about the data exceeding the limit range by the side of the newly set-up high brightness.

[0028] Thus, also by restricting the minimum level (the maximum intensity level) like drawing 6 according to the control signal from a control circuit 300, the amount of current which flows to an organic EL element is restricted, and the power consumption in an element can be reduced.

[0029] In addition, if a contrast control or intensity-level control is performed as shown in above-mentioned

drawing 5 and drawing 6 , even if the supply voltage control effect by the resistance 310 of drawing 4 is small, suppression of power consumption is realizable enough. Moreover, in the circuit of drawing 4 , it may not necessarily be resistance 310, and using the element in which other current detection of a coil etc. is possible, especially the supply voltage Vdd may not be controlled but a control signal may be created as composition which detects the amount of current which goes to the power supply line VL from a power circuit 200.
[0030] Moreover, in the above explanation, although the active-matrix type electroluminescence display was explained, it is applicable similarly about the passive type electroluminescence display which does not have a switching device in each pixel. That is, the maximum electric power consumption of equipment can be suppressed by controlling the amount of current which flows between EL elements based on the amount of current which flows on a power circuit and a panel power supply line. Moreover, the suppression of the maximum electric power consumption of equipment not only of an organic EL element but the display using other current drive type light emitting devices is attained by considering as the same composition.
[0031]
[Effect of the Invention] Since the amount of current passed to current drive type light emitting devices, such as each electroluminescent element, in this invention according to the amount of current which flows from this power supply to a display is controlled as explained above, it is controllable so that the power consumption as the whole display does not exceed the predetermined range. Moreover, by suppressing the amount of current which combined, and increased in the display when there were many luminescence pixels, a display becomes dazzling and it can prevent with a bird clapper that it is on the contrary hard to see.

[Translation done.]

TECHNICAL FIELD

[The technical field to which invention belongs] This invention relates to the display equipped with current drive type light emitting devices, such as an organic electroluminescence (below Electroluminescence: EL) element.

[Translation done.]

PRIOR ART

[Description of the Prior Art] It is observed as display which there are advantageous points, like its power consumption is thinly small while EL display is a spontaneous light type at each pixel, and replaces the EL element which is a current drive type light emitting device with display, such as a liquid crystal display (LCD) and CRT, and research is advanced.
[0003] Moreover, switching devices, such as TFT (TFT) which controls an EL element individually, are prepared in each pixel especially, and the active-matrix type EL display which controls an EL element for every pixel is expected as high definition display.
[0004] Drawing 7 shows the circuitry per pixel in the active-matrix type EL display of a m line n train. In EL display, two or more gate lines GL were prolonged on the substrate at the line writing direction, and two or more data lines DL and power supply lines VL are prolonged in the direction of a train in it. And near the field surrounded with the data line DL, and the power supply line VL and the gate line GL serves as a field by 1 pixel, and organic EL element 50, TFT10 for switching (the 1st TFT) and TFT20 for an EL-element drive (the 2nd TFT), and retention volume Cs are formed in this 1-pixel field.
[0005] It connects with the gate line GL and the data line DL, and 1st TFT10 is turned on in response to a gate signal (selection signal) in a gate electrode. The data signal currently supplied to the data line DL at this time is held at the retention volume Cs connected between 1st TFT10 and 2nd TFT20. The voltage according to the data signal held with the retention volume Cs supplied through the 1st above TFT 10 is impressed to the gate electrode of 2nd TFT20, and 2nd TFT20 supplies the current according to the gate voltage to organic EL element 50 from the power supply line VL. An organic EL element emits light by the luminescence brightness according to the data signal for every pixel, and a desired image is displayed by such operation.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] Since the amount of current passed to current drive type light emitting devices, such as each electroluminescent element, in this invention according to the amount of current which flows from this power supply to a display is controlled as explained above, it is controllable so that the power consumption as the whole display does not exceed the predetermined range. Moreover, by suppressing the amount of current which combined, and increased in the display when there were many luminescence pixels, a display becomes dazzling and it can prevent with a bird clapper that it is on the contrary hard to see.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Each EL element of organic EL display is a current drive type light emitting device which flows between anode plate-cathode and which carries out current ****** luminescence, and the whole consumed electric current increases, so that the power consumption as a panel is changed and the point emitting light increases with the number of the elements which emit light on a panel.
[0007] However, while the electronic equipment by which it is called for strongly that they are low powers, such as a display of a cellular phone, increases, in order to use organic EL display as a display of such a device, control of the power consumption, especially suppression of maximum electric power consumption are needed. Moreover, since an organic EL element generates heat by current drive, even if the voltage in the power supply line VL is fixed, it is also considered that the current value which flows to an organic EL element increases, and it may produce still more unnecessary power consumption. Therefore, it is **** rare ** to control the amount of current which flows for an element also from such a viewpoint.
[0008] this invention is made in view of the above-mentioned technical problem, and aims at enabling suppression of the maximum electric power consumption of display, such as an EL panel.

[Translation done.]

* NOTICES *

MEANS

[Means for Solving the Problem] The display in which two or more pixels equipped with the current drive type light emitting device constituted in preparation for between an anode plate and cathode at least in display in a luminous layer, as for this invention were prepared in order to attain the above-mentioned purpose, The power supply section which generates the power supply for making each current drive type light emitting device of the aforementioned display emit light, It is prepared between each current drive type light emitting device of the aforementioned power supply section and the aforementioned display, and is characterized by having the current control section which controls the amount of current passed to each current drive type light emitting device according to the amount of current from the aforementioned power supply section.
[0010] The current which flows from a power supply to a display increases, so that there are many pixels which current drive type light emitting devices, such as electroluminescent element, emit light in proportion to supply current, and emit light by the display, and equipment power consumption increases. Since the amount of current passed to each current drive type light emitting device according to the amount of current which flows toward a display from this power supply is controlled by this invention, even if there are many light emitting devices, the current which flows for each element is controlled in the range suitable as the whole display, and maximum electric power consumption is suppressed.
[0011] Other features of this invention are that the above-mentioned current control section decreases the amount of current which the supply voltage which will be impressed to each aforementioned current drive type light emitting device if the aforementioned amount of current increases is reduced, and flows to each aforementioned current drive type light emitting device. If the voltage of the power supply impressed to an element is reduced by such control, the current which flows for this element can be decreased easily and certainly.
[0012] Moreover, other features of this invention are controlling the contrast or the intensity level of an indicative data which in addition to the above-mentioned control is different from the above-mentioned control and a control section's supplies to each current drive type light emitting device.
[0013] Furthermore, other features of this invention are that a control section reduces the contrast or the intensity level of the aforementioned indicative data when the aforementioned amount of current increases.
[0014] Since the current according to the indicative data flowed and emitted light by each current drive type light emitting device, when the current supplied to a display from a power supply section increases, by reducing the contrast and the intensity level of an indicative data, the amount of current which flows for each element can be reduced, and the power consumption in a display can be suppressed certainly.
[0015]
[Embodiments of the Invention] Hereafter, the gestalt (henceforth an operation gestalt) of suitable implementation of this invention is explained using a drawing.
[0016] Drawing 1 shows the display circuitry of the active-matrix type EL display of the m line n train concerning the operation gestalt of this invention, and is the same as that of above-mentioned drawing 7 fundamentally. Each pixel prepared in a display is constituted near the field surrounded with the gate line GL prolonged in a line writing direction, and the data line DL and the power supply line VL which are prolonged in the direction of a train, and is equipped with organic EL element 50, TFT10 for switching (the 1st TFT), TFT20 for an element drive (the 2nd TFT), and retention volume Cs. [two or more] 1st TFT10 is turned on in response to a gate signal to the gate, and the data signal from a data line DL is held at the retention volume Cs connected with 1st TFT10 and 2nd TFT20 in between. 2nd TFT20 is formed between the power supply line VL and organic EL element 50 (element anode plate), and supplies the current according to the voltage value of the data signal impressed to the gate from the power supply line VL to organic EL element 50.

[0017] Drawing 2 shows an example of the cross-section structure of organic EL element 50 and 2nd TFT20. With this operation gestalt, it reaches 2nd TFT20, and all of 1st TFT10 are bottom gate type TFT, and use for the active layer the polycrystal silicon layer which polycrystal-ized and was obtained by laser annealing etc., respectively (however, ****** 1TFT10 ellipsis). the [the 1st and] -- 2TFT 10 and 20 -- a wrap -- like, all over the substrate, the flattening insulating layer 18 for upper surface flattening is formed, and organic EL element 50 is formed in the upper layer Between an anode plate (the 1st electrode : transparent electrode) 51 and the cathode (the 2nd electrode : metal electrode) 55 which was common to each pixel and was formed in the best layer, the laminating of the organic layer is carried out and organic EL element 50 is constituted. The anode plate 51 is connected with the source field of 2nd TFT20 through the contact hole formed so that the flattening insulating layer 18 and the layer insulation film 14 might be penetrated. Moreover, as for the organic layer, the laminating of the hole transporting bed 52 (the 1st hole transporting bed, the 2nd hole transporting bed), the organic luminous layer 53, and the electronic transporting bed 54 is carried out, for example to order from the anode plate side.
[0018] With this operation form, the anode plate 51 and the organic luminous layer 53 which organic EL element 50 becomes from ITO (Indium Tin Oxide) etc. are formed independently for every pixel, and the hole transporting beds 52 and the electronic transporting beds 54 other than these are common to each pixel, and they are formed. As an example, TPD (N, N'-diphenyl-N, N'-di(3-methylphenyl)-1, 1'-biphenyl-4, 4'-diamine) can be used for MTDATA (4, 4', 4"-tris(3-methylphenylphenylamino) triphenylamine) and the 2nd hole transporting bed by the 1st hole transporting bed. Although the organic luminous layer 53 changes for every pixel with luminescent color made into the purpose of R, G, and B, it contains BeBq2 (bis(10-hydroxybenzo[h] quinolinato) beryllium) containing a Quinacridone (Quinacridone) derivative, for example. BeBq2 can be used for the electronic transporting bed 54.
[0019] Drawing 3 shows the outline composition of the whole electroluminescence display concerning this operation gestalt. This display is equipped with the display panel 100, the power circuit 200, the current control circuit 300, and the display controller 500 of circuitry of drawing 1 . A power circuit 200 creates the drive current supplied to organic EL element 50. The current control circuit 300 controls the amount of current passed to each organic EL element 50 according to the amount of current which is prepared between a power circuit 200 and the power supply line VL of a display panel 100, and flows toward the power supply line VL from a power circuit 200 so that it may mention later. The display controller 500 has the video signal processing circuit 510, the synchronizing separation processing circuit 520, and timing controller (traveler's check) circuit 530 grade. The video signal processing section 510 processes a video input, and supplies R, G, and B-display data to organic EL panel 100, and the synchronizing separation processing circuit 520 separates a vertical synchronizing signal Vsync and a horizontal synchronizing signal Hsync from a video input. The traveler's check circuit 530 creates the timing signal for driving each pixel of a display panel 100 for a perpendicular, the level start pulse S and a perpendicular, a level clock, etc. based on the vertical synchronizing signal Vsync and horizontal synchronizing signal Hsync from the synchronizing separation processing circuit 520.
[0020] Next, the current control circuit 300 is explained. A voltage drop element, an inductance element, etc. can be used for the current control circuit 300, for example, resistance can constitute it. If it is common within a panel 100 as shown in drawing 1 , and the element number which emits light increases, the amount of current of the power supply line VL which supplies power to each EL element 50 which flows on the power supply line VL from a power circuit 200 will also increase. The resistance as a current control circuit 300 is prepared into the path to the power supply line VL from the power circuit 200 so that it may be this operation form, and the voltage drop (RI) according to the amount of current (I) which flowed to resistance (R) here occurs. And only "PVdd-RI" becomes low to the supply voltage PVdd in which the power circuit 200 generated the supply voltage Vdd by which the part voltage drop will be impressed to the power supply line VL by becoming large if the amount of current which flows to resistance increases. As mentioned above, in each pixel, the anode plate of organic EL element 50 is connected to the power supply line VL through the source drain of 2nd TFT20, and if the voltage of the power supply line VL falls, the current which flows to the anode plate of organic EL element 50 through 2nd TFT20 according to this will decrease. Therefore, when the amount of current between a power circuit 200 and the power supply line VL increases, the current which flows to each organic EL element 50 can be decreased by lowering the supply voltage Vdd supplied to the power supply line VL by resistance as a current control circuit 300. Thus, the amount of current in each organic EL element 50 can be controlled by controlling supply voltage Vdd according to the amount of current which flows on the power supply line VL from a power

circuit 200, and the power consumption as the whole display can be restricted by it.
[0021] Drawing 4 shows other examples of composition of the above-mentioned current control circuit 300. A control signal is generated according to the amount of current which flows toward the power supply line VL from a power circuit 200, and the contrast or the intensity level of a video signal which this supplies to each organic EL element 50 is controlled by this current control circuit 300. Moreover, control of supply voltage Vdd is also performed simultaneously.
[0022] In drawing 4 , the resistance 310 it is [resistance] a voltage drop element like [a circuit 300] the above between a power circuit 200 and the power supply line VL is formed, and supply voltage Vdd is lowered by the voltage drop according to the amount of current between a power circuit 200 and the power supply line VL. Moreover, in addition to the above-mentioned resistance 310, the current control circuit 300 is equipped with the control signal generating section 320 which creates the control signal according to the voltage between terminals of resistance 310. The video signal processing circuit 510 of the display controller 500 is supplied, and the video signal processing circuit 510 controls the contrast or the intensity level of a video signal according to this control signal so that a dotted line shows the control signal created in the control signal generating section 320 to drawing 3 .
[0023] The control signal generating section 320 is equipped with the 1st amplifier 322,324, the 2nd amplifier (subtractor circuit) 326, the 3rd amplifier 328, and the 4th amplifier (buffer) 330 in the example of drawing 4 . The right input of the 1st amplifier 322,324 is connected to the power supply line side edge of resistance 310, and the power circuit side edge, respectively. High impedance conversion of each terminal voltage of resistance 310 is carried out with the 1st amplifier 322,324, and it is impressed to the negative input of a subtractor circuit 326, and a right input through resistance, respectively. The absolute value of the case where the voltage between terminals in resistance 310, i.e., a voltage drop, is large, and the output voltage (difference output) from a subtractor circuit 326 becomes large. In the circuitry of drawing 4 , the subtractor circuit 326 is carrying out reversal amplification of the voltage between terminals, and the 3rd amplifier 328 inverts this difference partial output by which reversal amplification was carried out, and it outputs it to the 4th amplifier 330. The 4th amplifier 330 carries out impedance conversion of the signal from the 3rd amplifier 328, and supplies it to a control terminal as a control signal. The control signal which is created as mentioned above and outputted from a control terminal turns into a voltage signal according to the amount of current which flows on the power supply line VL from the voltage drop 200 in resistance 310, i.e., a power circuit.
[0024] Drawing 5 explains how the video signal processing circuit 510 controls the contrast of an indicative data based on the above-mentioned control signal. In drawing 5 , the solid line simplifies and shows the indicative data formed in a normal state, the minimum level of this indicative data is equivalent to the maximum intensity level (white) in EL element 50, and the maximum level means the minimum intensity level (black).
[0025] Organic EL element 50 passes the current according to the amplitude of such a video signal (indicative data), and emits light. Therefore, in order to reduce the contrast of an indicative data, the video signal processing circuit 510 raises the minimum level of a status signal according to a control signal, contracts the difference of the maximum intensity level and the minimum intensity level, and it compresses an indicative-data amplitude almost equally so that an indicative-data amplitude is settled between this new minimum level and the maximum level so that a drawing middle point line shows. In case compression of such an amplitude carries out analogue conversion of the gradation data contained for example, in a digital video signal, it can realize the voltage step per one gradation by usually making it smaller than the time.
[0026] According to the control signal (voltage level) from the current control circuit 300, the rise degree of the minimum level (white level) of a status signal is determined in this way, and the amount of current which flows to each organic EL element a gone up part of the minimum level of an indicative data decreases by supplying an organic EL element. Since the power consumption in an organic EL element will become so small if the amount of current which flows for an element becomes small, it can restrict the power consumption in an organic EL element by such control. Moreover, in contrast fall processing, in order to narrow the amplitude of an indicative data uniformly, the repeatability of an indicative data (especially gradation) is not spoiled and the reappearance capacity of an indicative data does not usually change with the time. Therefore, the power consumption of display can be restricted, without reducing the reappearance capacity of data by such contrast control.
[0027] Drawing 6 shows notionally how to control the intensity level of an indicative data based on a control signal. In drawing 6 , a solid line is the simple wave of the indicative data formed in a normal state like above-mentioned drawing 5 . When controlling an intensity level, the video signal processing section 510 raises the

brightness minimum level of drawing 6 according to the control signal from the current control circuit 300, as one-point **** shows. Thus, raising the minimum intensity level makes the maximum brightness (white) level fall, when it sees about element luminescence brightness. The white-level display (slash portion of drawing) which will be less than this alternate long and short dash line by this if it is usually at the time is restricted to the white-level display of the alternate long and short dash line newly set up according to the voltage level of a control signal. In case such brightness limit processing carries out analogue conversion of the digital brightness data contained for example, in a digital video signal, it can be realized by processing of considering all as setting level about the data exceeding the limit range by the side of the newly set-up high brightness.

[0028] Thus, also by restricting the minimum level (the maximum intensity level) like drawing 6 according to the control signal from a control circuit 300, the amount of current which flows to an organic EL element is restricted, and the power consumption in an element can be reduced.

[0029] In addition, if a contrast control or intensity-level control is performed as shown in above-mentioned drawing 5 and drawing 6 , even if the supply voltage control effect by the resistance 310 of drawing 4 is small, suppression of power consumption is realizable enough. Moreover, in the circuit of drawing 4 , it may not necessarily be resistance 310, and using the element in which other current detection of a coil etc. is possible, especially the supply voltage Vdd may not be controlled but a control signal may be created as composition which detects the amount of current which goes to the power supply line VL from a power circuit 200.

[0030] Moreover, in the above explanation, although the active-matrix type electroluminescence display was explained, it is applicable similarly about the passive type electroluminescence display which does not have a switching device in each pixel. That is, the maximum electric power consumption of equipment can be suppressed by controlling the amount of current which flows between EL elements based on the amount of current which flows on a power circuit and a panel power supply line. Moreover, the suppression of the maximum electric power consumption of equipment not only of an organic EL element but the display using other current drive type light emitting devices is attained by considering as the same composition.

[Translation done.]

MEANS

[Means for Solving the Problem] The display in which two or more pixels equipped with the current drive type light emitting device constituted in preparation for between an anode plate and cathode at least in display in a luminous layer, as for this invention were prepared in order to attain the above-mentioned purpose, The power supply section which generates the power supply for making each current drive type light emitting device of the aforementioned display emit light, It is prepared between each current drive type light emitting device of the aforementioned power supply section and the aforementioned display, and is characterized by having the current control section which controls the amount of current passed to each current drive type light emitting device according to the amount of current from the aforementioned power supply section.
[0010] The current which flows from a power supply to a display increases, so that there are many pixels which current drive type light emitting devices, such as electroluminescent element, emit light in proportion to supply current, and emit light by the display, and equipment power consumption increases. Since the amount of current passed to each current drive type light emitting device according to the amount of current which flows toward a display from this power supply is controlled by this invention, even if there are many light emitting devices, the current which flows for each element is controlled in the range suitable as the whole display, and maximum electric power consumption is suppressed.
[0011] Other features of this invention are that the above-mentioned current control section decreases the amount of current which the supply voltage which will be impressed to each aforementioned current drive type light emitting device if the aforementioned amount of current increases is reduced, and flows to each aforementioned current drive type light emitting device. If the voltage of the power supply impressed to an element is reduced by such control, the current which flows for this element can be decreased easily and certainly.
[0012] Moreover, other features of this invention are controlling the contrast or the intensity level of an indicative data which in addition to the above-mentioned control is different from the above-mentioned control and a control section's supplies to each current drive type light emitting device.
[0013] Furthermore, other features of this invention are that a control section reduces the contrast or the intensity level of the aforementioned indicative data when the aforementioned amount of current increases.
[0014] Since the current according to the indicative data flowed and emitted light by each current drive type light emitting device, when the current supplied to a display from a power supply section increases, by reducing the contrast and the intensity level of an indicative data, the amount of current which flows for each element can be reduced, and the power consumption in a display can be suppressed certainly.
[0015]
[Embodiments of the Invention] Hereafter, the gestalt (henceforth an operation gestalt) of suitable implementation of this invention is explained using a drawing.
[0016] Drawing 1 shows the display circuitry of the active-matrix type EL display of the m line n train concerning the operation gestalt of this invention, and is the same as that of above-mentioned drawing 7 fundamentally. Each pixel prepared in a display is constituted near the field surrounded with the gate line GL prolonged in a line writing direction, and the data line DL and the power supply line VL which are prolonged in the direction of a train, and is equipped with organic EL element 50, TFT10 for switching (the 1st TFT), TFT20 for an element drive (the 2nd TFT), and retention volume Cs. [two or more] 1st TFT10 is turned on in response to a gate signal to the gate, and the data signal from a data line DL is held at the retention volume Cs connected with 1st TFT10 and 2nd TFT20 in between. 2nd TFT20 is formed between the power supply line VL and organic EL element 50 (element anode plate), and supplies the current according to the voltage value of the data signal impressed to the gate from the power supply line VL to organic EL element 50.

[0017] Drawing 2 shows an example of the cross-section structure of organic EL element 50 and 2nd TFT20. With this operation gestalt, it reaches 2nd TFT20, and all of 1st TFT10 are bottom gate type TFT, and use for the active layer the polycrystal silicon layer which polycrystal-ized and was obtained by laser annealing etc., respectively (however, ****** 1TFT10 ellipsis). the [the 1st and] -- 2TFT 10 and 20 -- a wrap -- like, all over the substrate, the flattening insulating layer 18 for upper surface flattening is formed, and organic EL element 50 is formed in the upper layer Between an anode plate (the 1st electrode : transparent electrode) 51 and the cathode (the 2nd electrode : metal electrode) 55 which was common to each pixel and was formed in the best layer, the laminating of the organic layer is carried out and organic EL element 50 is constituted. The anode plate 51 is connected with the source field of 2nd TFT20 through the contact hole formed so that the flattening insulating layer 18 and the layer insulation film 14 might be penetrated. Moreover, as for the organic layer, the laminating of the hole transporting bed 52 (the 1st hole transporting bed, the 2nd hole transporting bed), the organic luminous layer 53, and the electronic transporting bed 54 is carried out, for example to order from the anode plate side.
[0018] With this operation form, the anode plate 51 and the organic luminous layer 53 which organic EL element 50 becomes from ITO (Indium Tin Oxide) etc. are formed independently for every pixel, and the hole transporting beds 52 and the electronic transporting beds 54 other than these are common to each pixel, and they are formed. As an example, TPD (N, N'-diphenyl-N, N'-di(3-methylphenyl)-1, 1'-biphenyl-4, 4'-diamine) can be used for MTDATA (4, 4', 4"-tris(3-methylphenylphenylamino) triphenylamine) and the 2nd hole transporting bed by the 1st hole transporting bed. Although the organic luminous layer 53 changes for every pixel with luminescent color made into the purpose of R, G, and B, it contains BeBq2 (bis(10-hydroxybenzo[h] quinolinato) beryllium) containing a Quinacridone (Quinacridone) derivative, for example. BeBq2 can be used for the electronic transporting bed 54.
[0019] Drawing 3 shows the outline composition of the whole electroluminescence display concerning this operation gestalt. This display is equipped with the display panel 100, the power circuit 200, the current control circuit 300, and the display controller 500 of circuitry of drawing 1 . A power circuit 200 creates the drive current supplied to organic EL element 50. The current control circuit 300 controls the amount of current passed to each organic EL element 50 according to the amount of current which is prepared between a power circuit 200 and the power supply line VL of a display panel 100, and flows toward the power supply line VL from a power circuit 200 so that it may mention later. The display controller 500 has the video signal processing circuit 510, the synchronizing separation processing circuit 520, and timing controller (traveler's check) circuit 530 grade. The video signal processing section 510 processes a video input, and supplies R, G, and B-display data to organic EL panel 100, and the synchronizing separation processing circuit 520 separates a vertical synchronizing signal Vsync and a horizontal synchronizing signal Hsync from a video input. The traveler's check circuit 530 creates the timing signal for driving each pixel of a display panel 100 for a perpendicular, the level start pulse S and a perpendicular, a level clock, etc. based on the vertical synchronizing signal Vsync and horizontal synchronizing signal Hsync from the synchronizing separation processing circuit 520.
[0020] Next, the current control circuit 300 is explained. A voltage drop element, an inductance element, etc. can be used for the current control circuit 300, for example, resistance can constitute it. If it is common within a panel 100 as shown in drawing 1 , and the element number which emits light increases, the amount of current of the power supply line VL which supplies power to each EL element 50 which flows on the power supply line VL from a power circuit 200 will also increase. The resistance as a current control circuit 300 is prepared into the path to the power supply line VL from the power circuit 200 so that it may be this operation form, and the voltage drop (RI) according to the amount of current (I) which flowed to resistance (R) here occurs. And only "PVdd-RI" becomes low to the supply voltage PVdd in which the power circuit 200 generated the supply voltage Vdd by which the part voltage drop will be impressed to the power supply line VL by becoming large if the amount of current which flows to resistance increases. As mentioned above, in each pixel, the anode plate of organic EL element 50 is connected to the power supply line VL through the source drain of 2nd TFT20, and if the voltage of the power supply line VL falls, the current which flows to the anode plate of organic EL element 50 through 2nd TFT20 according to this will decrease. Therefore, when the amount of current between a power circuit 200 and the power supply line VL increases, the current which flows to each organic EL element 50 can be decreased by lowering the supply voltage Vdd supplied to the power supply line VL by resistance as a current control circuit 300. Thus, the amount of current in each organic EL element 50 can be controlled by controlling supply voltage Vdd according to the amount of current which flows on the power supply line VL from a power

circuit 200, and the power consumption as the whole display can be restricted by it.
[0021] Drawing 4 shows other examples of composition of the above-mentioned current control circuit 300. A control signal is generated according to the amount of current which flows toward the power supply line VL from a power circuit 200, and the contrast or the intensity level of a video signal which this supplies to each organic EL element 50 is controlled by this current control circuit 300. Moreover, control of supply voltage Vdd is also performed simultaneously.
[0022] In drawing 4 , the resistance 310 it is [resistance] a voltage drop element like [a circuit 300] the above between a power circuit 200 and the power supply line VL is formed, and supply voltage Vdd is lowered by the voltage drop according to the amount of current between a power circuit 200 and the power supply line VL. Moreover, in addition to the above-mentioned resistance 310, the current control circuit 300 is equipped with the control signal generating section 320 which creates the control signal according to the voltage between terminals of resistance 310. The video signal processing circuit 510 of the display controller 500 is supplied, and the video signal processing circuit 510 controls the contrast or the intensity level of a video signal according to this control signal so that a dotted line shows the control signal created in the control signal generating section 320 to drawing 3 .
[0023] The control signal generating section 320 is equipped with the 1st amplifier 322,324, the 2nd amplifier (subtractor circuit) 326, the 3rd amplifier 328, and the 4th amplifier (buffer) 330 in the example of drawing 4 . The right input of the 1st amplifier 322,324 is connected to the power supply line side edge of resistance 310, and the power circuit side edge, respectively. High impedance conversion of each terminal voltage of resistance 310 is carried out with the 1st amplifier 322,324, and it is impressed to the negative input of a subtractor circuit 326, and a right input through resistance, respectively. The absolute value of the case where the voltage between terminals in resistance 310, i.e., a voltage drop, is large, and the output voltage (difference output) from a subtractor circuit 326 becomes large. In the circuitry of drawing 4 , the subtractor circuit 326 is carrying out reversal amplification of the voltage between terminals, and the 3rd amplifier 328 inverts this difference partial output by which reversal amplification was carried out, and it outputs it to the 4th amplifier 330. The 4th amplifier 330 carries out impedance conversion of the signal from the 3rd amplifier 328, and supplies it to a control terminal as a control signal. The control signal which is created as mentioned above and outputted from a control terminal turns into a voltage signal according to the amount of current which flows on the power supply line VL from the voltage drop 200 in resistance 310, i.e., a power circuit.
[0024] Drawing 5 explains how the video signal processing circuit 510 controls the contrast of an indicative data based on the above-mentioned control signal. In drawing 5 , the solid line simplifies and shows the indicative data formed in a normal state, the minimum level of this indicative data is equivalent to the maximum intensity level (white) in EL element 50, and the maximum level means the minimum intensity level (black).
[0025] Organic EL element 50 passes the current according to the amplitude of such a video signal (indicative data), and emits light. Therefore, in order to reduce the contrast of an indicative data, the video signal processing circuit 510 raises the minimum level of a status signal according to a control signal, contracts the difference of the maximum intensity level and the minimum intensity level, and it compresses an indicative-data amplitude almost equally so that an indicative-data amplitude is settled between this new minimum level and the maximum level so that a drawing middle point line shows. In case compression of such an amplitude carries out analogue conversion of the gradation data contained for example, in a digital video signal, it can realize the voltage step per one gradation by usually making it smaller than the time.
[0026] According to the control signal (voltage level) from the current control circuit 300, the rise degree of the minimum level (white level) of a status signal is determined in this way, and the amount of current which flows to each organic EL element a gone up part of the minimum level of an indicative data decreases by supplying an organic EL element. Since the power consumption in an organic EL element will become so small if the amount of current which flows for an element becomes small, it can restrict the power consumption in an organic EL element by such control. Moreover, in contrast fall processing, in order to narrow the amplitude of an indicative data uniformly, the repeatability of an indicative data (especially gradation) is not spoiled and the reappearance capacity of an indicative data does not usually change with the time. Therefore, the power consumption of display can be restricted, without reducing the reappearance capacity of data by such contrast control.
[0027] Drawing 6 shows notionally how to control the intensity level of an indicative data based on a control signal. In drawing 6 , a solid line is the simple wave of the indicative data formed in a normal state like above-mentioned drawing 5 . When controlling an intensity level, the video signal processing section 510 raises the

brightness minimum level of drawing 6 according to the control signal from the current control circuit 300, as one-point **** shows. Thus, raising the minimum intensity level makes the maximum brightness (white) level fall, when it sees about element luminescence brightness. The white-level display (slash portion of drawing) which will be less than this alternate long and short dash line by this if it is usually at the time is restricted to the white-level display of the alternate long and short dash line newly set up according to the voltage level of a control signal. In case such brightness limit processing carries out analogue conversion of the digital brightness data contained for example, in a digital video signal, it can be realized by processing of considering all as setting level about the data exceeding the limit range by the side of the newly set-up high brightness.

[0028] Thus, also by restricting the minimum level (the maximum intensity level) like drawing 6 according to the control signal from a control circuit 300, the amount of current which flows to an organic EL element is restricted, and the power consumption in an element can be reduced.

[0029] In addition, if a contrast control or intensity-level control is performed as shown in above-mentioned drawing 5 and drawing 6 , even if the supply voltage control effect by the resistance 310 of drawing 4 is small, suppression of power consumption is realizable enough. Moreover, in the circuit of drawing 4 , it may not necessarily be resistance 310, and using the element in which other current detection of a coil etc. is possible, especially the supply voltage Vdd may not be controlled but a control signal may be created as composition which detects the amount of current which goes to the power supply line VL from a power circuit 200.

[0030] Moreover, in the above explanation, although the active-matrix type electroluminescence display was explained, it is applicable similarly about the passive type electroluminescence display which does not have a switching device in each pixel. That is, the maximum electric power consumption of equipment can be suppressed by controlling the amount of current which flows between EL elements based on the amount of current which flows on a power circuit and a panel power supply line. Moreover, the suppression of the maximum electric power consumption of equipment not only of an organic EL element but the display using other current drive type light emitting devices is attained by considering as the same composition.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the circuitry of the organic EL panel concerning the operation gestalt of this invention.
[Drawing 2] It is drawing showing the outline cross-section composition of the organic EL-element section concerning the operation gestalt of this invention.
[Drawing 3] It is drawing showing the whole organic EL display composition concerning this invention.
[Drawing 4] It is drawing showing the example of composition of the current control circuit concerning the operation gestalt of this invention.
[Drawing 5] It is drawing explaining the method of the contrast fall control concerning the operation gestalt of this invention.
[Drawing 6] It is drawing explaining the method of the brightness fall control concerning the operation gestalt of this invention.
[Drawing 7] It is drawing showing the 1-pixel circuitry of the conventional active-matrix type organic EL display.
[Description of Notations]
1 Substrate (Transparent Substrate), 4 Gate Insulator Layer, 16 Active Layer (P-si Film), 10 The 1st TFT (TFT for switching), 14 Layer insulation film, 18 A flattening insulating layer, 20 The 2nd TFT (TFT for an element drive), 25 A gate electrode, 50 An organic EL element, 51 An anode plate, 52 Hole transporting bed, 53 An organic luminous layer, 54 An electronic transporting bed, 55 Cathode, 100 Display panel, 200 A power circuit, 300 A current control circuit, 310 Resistance, 320 Control signal generating section, 322,324 The 1st amplifier, 326 The 2nd amplifier (subtractor circuit), 328 The 3rd amplifier, 330 The 4th amplifier, 340 A control terminal, 500 A display controller, 510 A video signal processing circuit, GL A gate line, VL A power supply line, DL Data line.

[Translation done.]

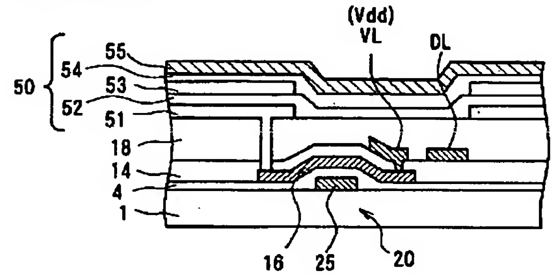
* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

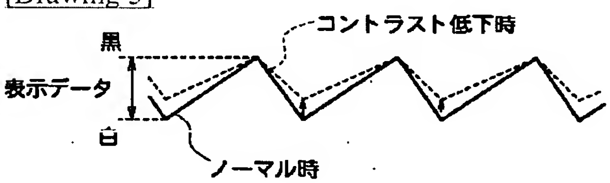
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

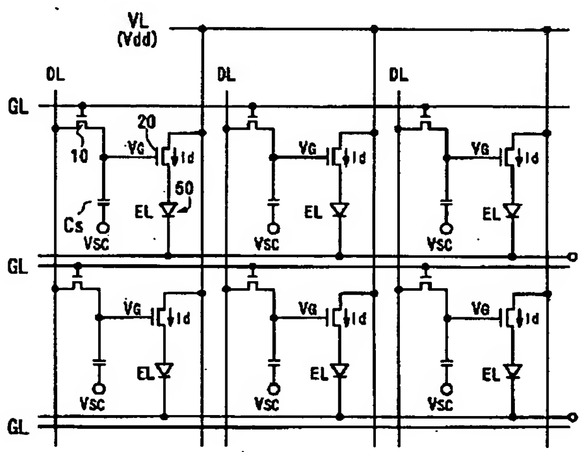
[Drawing 2]



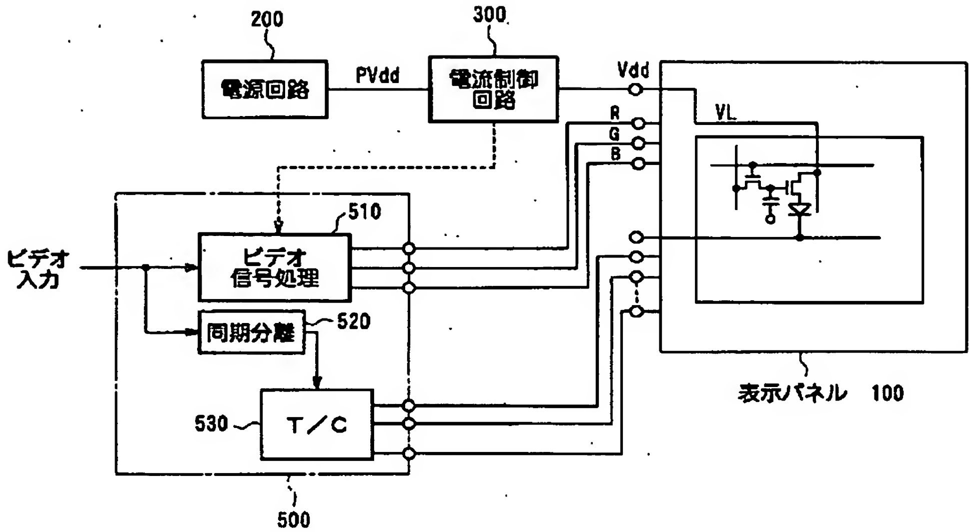
[Drawing 5]



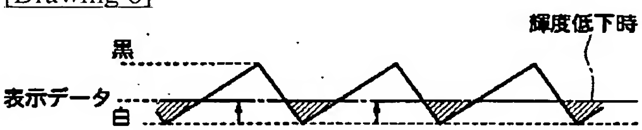
[Drawing 1]



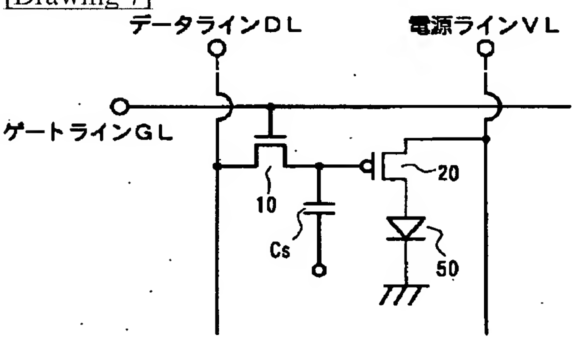
[Drawing 3]



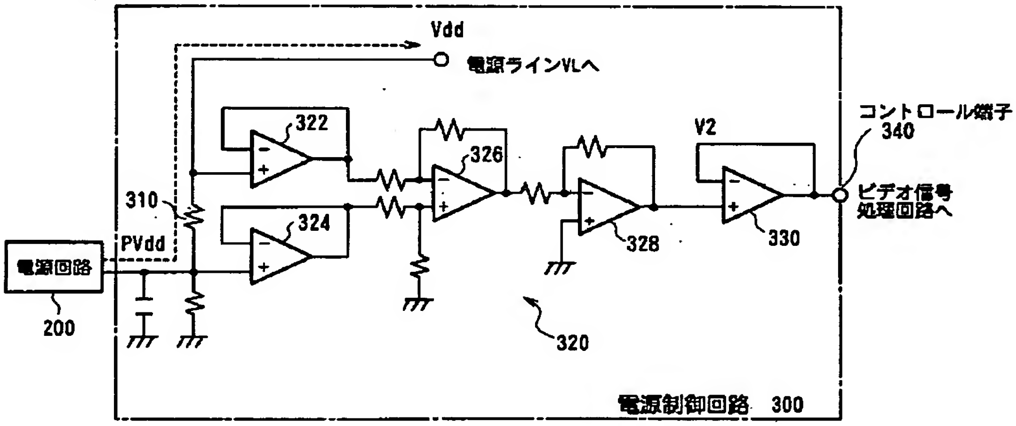
[Drawing 6]



[Drawing 7]



[Drawing 4]



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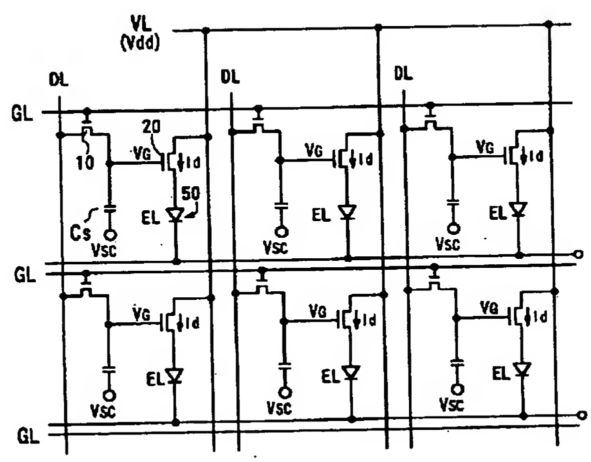
(54)【発明の名称】　表示装置

(57)【要約】
【課題】　ＥＬなど電流駆動素子を有する表示装置での消費電力を制御すること。
【解決手段】　電源回路２００と、表示パネルの各発光画素に設けられた有機ＥＬ素子５０に駆動電流を供給する電源ラインＶＬとの間に電流制御回路３００を設け、電源回路２００から電源ラインＶＬに流れる電流量を検出し、その電流量が増加すると電源ラインＶＬに印加する電源電圧Vddを低下させ、その結果有機ＥＬ素子５０に流れる電流を減少させる。或いは、検出した電流量に応じて各ＥＬ素子５０に供給する表示データのコントラストや、輝度レベルを制御し、電流量が増加するとコントラストや輝度レベルを低下させ、有機ＥＬ素子５０に流れる電流を制限する。これらにより、有機ＥＬ素子５０に流れる電流量が制限され、表示装置の消費電力が過大にならないよう制御できる。



【特許請求の範囲】

【請求項１】 表示装置において、
陽極及び陰極の間に少なくとも発光層を備えて構成される電流駆動型発光素子を備える画素が複数設けられた表示部と、
前記表示部の各電流駆動型発光素子を発光させるための電源を発生する電源部と、
前記電源部と前記表示部の各電流駆動型発光素子との間に設けられ、前記電源部からの電流量に応じて各電流駆動型発光素子に流す電流量を制御する電流制御部と、
を備えることを特徴とする表示装置。

【請求項２】 請求項１に記載の表示装置において、
前記電流制御部は、前記電流量が増加すると前記各電流駆動型発光素子に供給される電源電圧を低下させて該電流駆動型発光素子に流れる電流量を減少させることを特徴とする表示装置。

【請求項３】 請求項１又は請求項２に記載の表示装置において、
前記電流制御部は、各電流駆動型発光素子に供給する表示データのコントラスト又は輝度レベルを制御することを特徴とする表示装置。

【請求項４】 請求項３に記載の表示装置において、
前記電流制御部は、前記電流量が増加すると前記表示データのコントラスト又は輝度レベルを低下させることを特徴とする表示装置。

【発明の詳細な説明】

【０００１】
【発明の属する技術分野】この発明は、有機エレクトロルミネッセンス（Electroluminescence：以下ＥＬ）素子などの電流駆動型発光素子を備えた表示装置に関する。

【０００２】
【従来の技術】電流駆動型の発光素子であるＥＬ素子を各画素にＥＬ表示装置は、自発光型であると共に、薄く消費電力が小さい等の有利な点があり、液晶表示装置（ＬＣＤ）やＣＲＴなどの表示装置に代わる表示装置として注目され、研究が進められている。

【０００３】また、なかでも、ＥＬ素子を個別に制御する薄膜トランジスタ（ＴＦＴ）などのスイッチ素子を各画素に設け、画素毎にＥＬ素子を制御するアクティブマトリクス型ＥＬ表示装置は、高精細な表示装置として期待されている。

【０００４】図7は、m行n列のアクティブマトリクス型ＥＬ表示装置における１画素当たりの回路構成を示している。ＥＬ表示装置では、基板上に複数本のゲートラインＧＬが行方向に延び、複数本のデータラインＤＬ及び電源ラインＶＬが列方向に延びている。そして、データラインＤＬ及び電源ラインＶＬと、ゲートラインＧＬとで囲まれた領域付近が１画素相当領域となり、この１画素領域には有機ＥＬ素子５０と、スイッチング用ＴＦＴ（第1ＴＦＴ）１０、ＥＬ素子駆動用ＴＦＴ（第2ＴＦＴ）２０及び保持容量Ｃｓが設けられている。

【０００５】第1ＴＦＴ１０は、ゲートラインＧＬとデータラインＤＬとに接続されており、ゲート電極にゲート信号（選択信号）を受けてオンする。このときデータラインＤＬに供給されているデータ信号は第１ＴＦＴ１０と第2ＴＦＴ２０との間に接続された保持容量Ｃｓに保持される。第2ＴＦＴ２０のゲート電極には、上記第１ＴＦＴ１０を介して供給された保持容量Ｃｓで保持されるデータ信号に応じた電圧が印加され、第2ＴＦＴ２０は、ゲート電圧に応じた電流を電源ラインＶＬから有機ＥＬ素子５０に供給する。このような動作により、各画素ごとにデータ信号に応じた発光輝度で有機ＥＬ素子が発光し、所望のイメージが表示される。

【０００６】
【発明が解決しようとする課題】有機ＥＬ表示装置の各ＥＬ素子は陽極－陰極間に流れる電流応じて発光する電流駆動型発光素子であり、パネル上で発光する素子の数によってパネルとしての消費電力が変動し、発光点が増えるほど全体の消費電流が増大する。

【０００７】しかし、携帯電話のディスプレイなど低消費電力であることが強く求められる電子機器等が増えるなか、そのような機器のディスプレイとして有機ＥＬ表示装置を用いるには、その消費電力の制御、特に最大消費電力の抑制が必要となる。また、有機ＥＬ素子は、電流駆動により発熱するため、電源ラインＶＬにおける電圧が一定であっても有機ＥＬ素子に流れる電流値が増加することも考えられ、さらに不要な電力消費を生ずる可能性もある。従って、このような観点からも素子に流れる電流量を制御することがが望まれる。

【０００８】本発明は、上記課題に鑑みなされたものであり、ＥＬパネルなどの表示装置の最大消費電力の抑制を可能とすることを目的とする。

【０００９】
【課題を解決するための手段】上記目的を達成するためにこの発明は、表示装置において、陽極及び陰極の間に少なくとも発光層を備えて構成される電流駆動型発光素子を備える画素が複数設けられた表示部と、前記表示部の各電流駆動型発光素子を発光させるための電源を発生する電源部と、前記電源部と前記表示部の各電流駆動型発光素子との間に設けられ、前記電源部からの電流量に応じて各電流駆動型発光素子に流す電流量を制御する電流制御部と、を備えることを特徴とする。

【００１０】エレクトロルミネッセンス素子等の電流駆動型発光素子は供給電流に比例して発光し、表示部で発光する画素が多いほど電源から表示部に流れる電流が増大し、装置消費電力が増大する。本発明では、この電源から表示部に向かって流れる電流量に応じて各電流駆動型発光素子に流す電流量を制御するので、発光素子数が多くても各素子に流れる電流を表示部全体として適切な

範囲に制御し、最大消費電力を抑制する。

【0011】本発明の他の特徴は、上記電流制御部が、前記電流量が増加すると前記各電流駆動型発光素子に印加する電源電圧を低下させて前記各電流駆動型発光素子に流れる電流量を減少させることである。このような制御により、素子に印加する電源の電圧を低下させればこの素子に流れる電流を容易かつ確実に減少させることができる。

【0012】また、本発明の他の特徴は、上記制御に加えて、又は上記制御とは別で、制御部が、各電流駆動型発光素子に供給する表示データのコントラスト又は輝度レベルを制御することである。

【0013】さらに本発明の他の特徴は、制御部が前記電流量が増加したときに前記表示データのコントラスト又は輝度レベルを低下させることである。

【0014】各電流駆動型発光素子で、表示データに応じた電流が流れて発光するので、電源部から表示部に供給される電流が増大した場合、表示データのコントラストや輝度レベルを低下させることで、各素子に流れる電流量を低下させることができ、表示部での電力消費を確実に抑制することができる。

【0015】

【発明の実施の形態】以下、図面を用いてこの発明の好適な実施の形態（以下実施形態という）について説明する。

【0016】図1は、本発明の実施形態に係るm行n列のアクティブマトリクス型ＥＬ表示装置の表示部回路構成を示しており、基本的に上述の図7と同様である。表示部に複数設けられる各画素は、行方向に延びるゲートラインＧＬと、列方向に延びるデータラインＤＬ及び電源ラインＶＬとで囲まれる領域付近に構成され、有機ＥＬ素子５０、スイッチング用ＴＦＴ（第1ＴＦＴ）１０、素子駆動用ＴＦＴ（第2ＴＦＴ）２０及び保持容量Ｃｓを備える。第1ＴＦＴ１０は、ゲート信号をそのゲートに受けてオンし、第1ＴＦＴ１０と第2ＴＦＴ２０と間に接続された保持容量Ｃｓに、データラインＤＬからのデータ信号が保持される。第2ＴＦＴ２０は、電源ラインＶＬと、有機ＥＬ素子５０（素子陽極）との間に設けられ、そのゲートに印加されるデータ信号の電圧値に応じた電流を電源ラインＶＬから有機ＥＬ素子５０に供給する。

【0017】図2は、有機ＥＬ素子５０と第2ＴＦＴ２０の断面構造の一例を示している。本実施形態では、第2ＴＦＴ２０及び第1ＴＦＴ１０のいずれもボトムゲート型ＴＦＴであり、能動層には、レーザアニール等で多結晶化して得た多結晶シリコン層をそれぞれ用いている（但し図中第1ＴＦＴ１０は省略）。第1及び第2ＴＦＴ１０及び２０を覆うように基板全面に、上面平坦化のための平坦化絶縁層１８が形成されており、その上層に有機ＥＬ素子５０が形成されている。有機ＥＬ素子５０は、陽極（第1電極：透明電極）５１と、最上層に各画素共通で形成された陰極（第2電極：金属電極）５５との間に有機層が積層されて構成されている。陽極５１は、平坦化絶縁層１８と層間絶縁膜１４を貫通するように形成されたコンタクトホールを介して第2ＴＦＴ２０のソース領域と接続されている。また有機層は、陽極側から、例えばホール輸送層５２（第1ホール輸送層、第2ホール輸送層）、有機発光層５３、電子輸送層５４が順に積層されている。

【0018】本実施形態では、有機ＥＬ素子５０は、ＩＴＯ（Indium Tin Oxide）などからなる陽極５１と有機発光層５３は画素毎に独立して形成され、これら以外のホール輸送層５２と電子輸送層５４は各画素共通で形成されている。一例として、第1ホール輸送層は、ＭＴＤＡＴＡ（4,4',4''-tris(3-methylphenylphenylamino)triphenylamine）、第2ホール輸送層は、ＴＰＤ（N,N'-diphenyl-N,N'-di(3-methylphenyl)-1,1'-biphenyl-4,4'-diamine）を用いることができる。有機発光層５３は、Ｒ，Ｇ，Ｂの目的とする発光色によって画素毎に異なるが、例えば、キナクリドン（Quinacridone）誘導体を含む$BeBq_2$（bis(10-hydroxybenzo[h]quinolinato)beryllium）を含む。電子輸送層５４は、例えば$BeBq_2$を用いることができる。

【0019】図3は、本実施形態に係るエレクトロルミネッセンス表示装置全体の概略構成を示している。この表示装置は、図1の回路構成の表示パネル１００、電源回路２００、電流制御回路３００及び表示コントローラ５００を備える。電源回路２００は、有機ＥＬ素子５０に供給する駆動電流を作成する。電流制御回路３００は、電源回路２００と、表示パネル１００の電源ラインＶＬとの間に設けられ、後述するように電源回路２００から電源ラインＶＬに向かって流れる電流量に応じて各有機ＥＬ素子５０に流す電流量を制御する。表示コントローラ５００は、ビデオ信号処理回路５１０、同期分離処理回路５２０、タイミングコントローラ（Ｔ／Ｃ）回路５３０等を有する。ビデオ信号処理部５１０は、ビデオ入力を処理して有機ＥＬパネル１００にＲ，Ｇ，Ｂ表示データを供給し、同期分離処理回路５２０は、ビデオ入力から垂直同期信号Vsyncや、水平同期信号Hsyncを分離する。Ｔ／Ｃ回路５３０は、同期分離処理回路５２０からの垂直同期信号Vsync、水平同期信号Hsyncに基づいて、垂直、水平スタートパルスＳや垂直、水平クロック等、表示パネル１００の各画素を駆動するためのタイミング信号を作成する。

【0020】次に、電流制御回路３００について説明する。電流制御回路３００は、電圧降下素子、インダクタンス素子などが採用可能であり、例えば抵抗によって構成することができる。各ＥＬ素子５０に電力を供給する電源ラインＶＬは、図1に示すようにパネル１００内で共通であり、発光する素子数が増加すると電源回路２０

0から電源ラインＶＬに流れる電流量も多くなる。本実施形態のよう電流制御回路３００としての抵抗は、電源回路２００から電源ラインＶＬへの経路中に設けられており、ここでは抵抗（Ｒ）に流れた電流量（Ｉ）に応じた電圧降下（ＲＩ）が発生する。そして、抵抗に流れる電流量が多くなるとその分電圧降下が大きくなり、電源ラインＶＬに印加される電源電圧Vddは、電源回路２００の発生した電源電圧PVddに対し、「PVdd－ＲＩ」だけ低くなる。上述のように、各画素において、有機ＥＬ素子５０の陽極は、第２ＴＦＴ２０のソースドレインを介して電源ラインＶＬに接続されており、電源ラインＶＬの電圧が下がれば、これに応じて第２ＴＦＴ２０を介して有機ＥＬ素子５０の陽極に流れる電流が減少する。従って、電源回路２００と電源ラインＶＬとの間の電流量が多くなったときに、電流制御回路３００としての抵抗によって、電源ラインＶＬに供給される電源電圧Ｖddを下げることで、各有機ＥＬ素子５０に流れる電流を減少させることができる。このように電源回路２００から電源ラインＶＬに流れる電流量に応じて電源電圧Ｖddを制御することで、各有機ＥＬ素子５０での電流量を制御し、表示部全体としての電力消費を制限することができる。

【００２１】図4は、上記電流制御回路３００の他の構成例を示している。この電流制御回路３００では、電源回路２００から電源ラインＶＬに向かって流れる電流量に応じて制御信号を発生し、これにより各有機ＥＬ素子５０に供給するビデオ信号のコントラスト又は輝度レベルを制御する。また、同時に電源電圧Ｖddの制御も行っている。

【００２２】図4において回路３００は、電源回路２００と電源ラインＶＬとの間に上記と同様に電圧降下素子である抵抗３１０が設けられており、電源回路２００と電源ラインＶＬとの間の電流量に応じて電源電圧Ｖddが電圧降下分だけ下げられる。また、電流制御回路３００は、上記抵抗３１０に加え、抵抗３１０の端子間電圧に応じた制御信号を作成する制御信号発生部３２０を備える。制御信号発生部３２０で作成される制御信号は、図3に点線で示すように、表示コントローラ５００のビデオ信号処理回路５１０に供給され、ビデオ信号処理回路５１０は、この制御信号に応じてビデオ信号のコントラスト又は輝度レベルを制御する。

【００２３】制御信号発生部３２０は、図4の例では第1アンプ３２２，３２４、第２アンプ（減算回路）３２６、第3アンプ３２８及び第４アンプ（バッファ）３３０を備える。第1アンプ３２２，３２４の正入力は、それぞれ抵抗３１０の電源ライン側端、電源回路側端に接続されている。抵抗３１０の各端子電圧は第１アンプ３２２，３２４で高インピーダンス変換され、抵抗を介して減算回路３２６の負入力、正入力にそれぞれ印加される。抵抗３１０における端子間電圧、即ち電圧降下が大きい場合と、減算回路３２６からの出力電圧（差分出力）の絶対値が大きくなる。図４の回路構成では、減算回路３２６は端子間電圧を反転増幅しており、第3アンプ３２８は、この反転増幅された差分出力を極性反転して第４アンプ３３０に出力する。第４アンプ３３０は第３アンプ３２８からの信号をインピーダンス変換し、コントロール端子に制御信号として供給する。以上のようにして作成されコントロール端子から出力される制御信号は、抵抗３１０での電圧降下、即ち電源回路２００から電源ラインＶＬに流れる電流量に応じた電圧信号となる。

【００２４】図5は、上記制御信号に基づいてビデオ信号処理回路５１０が表示データのコントラストを制御する方法を説明している。図5において、実線は通常状態において形成される表示データを簡略化して示しており、この表示データの最小レベルはＥＬ素子５０での最大輝度レベル（白）に相当し、最大レベルは最小輝度レベル（黒）を意味する。

【００２５】有機ＥＬ素子５０は、このようなビデオ信号（表示データ）の振幅に応じた電流を流して発光する。従って、表示データのコントラストを低下させるために、ビデオ信号処理回路５１０は、図中点線で示すように、制御信号に応じて表示信号の最小レベルを上昇させて最大輝度レベルと最小輝度レベルとの差を縮め、この新最小レベルと最大レベルとの間に表示データ振幅が収まるように表示データ振幅をほぼ均等に圧縮する。このような振幅の圧縮は、例えば、デジタルビデオ信号に含まれる階調データをアナログ変換する際に、１階調当たりの電圧ステップを通常時より小さくすることで実現できる。

【００２６】電流制御回路３００からの制御信号（電圧レベル）に応じてこのように表示信号の最小レベル（白レベル）の上昇度合いを決定して、有機ＥＬ素子に供給することで、表示データの最小レベルの上昇分だけ各有機ＥＬ素子に流れる電流量が減少する。有機ＥＬ素子での消費電力は、素子に流れる電流量が小さくなればそれだけ小さくなるので、このような制御により、有機ＥＬ素子での電力消費を制限することができる。また、コントラスト低下処理では、表示データの振幅を均一に狭めるため、表示データ（特に階調）の再現性は損われず、表示データの再現能力は通常時と変わらない。よって、このようなコントラスト制御によりデータの再現能力を低下させることなく、表示装置の消費電力を制限することができる。

【００２７】図6は、制御信号に基づいて表示データの輝度レベルを制御する方法を概念的に示している。図6において、実線は、上記図５と同様、通常状態において形成される表示データの簡略波形である。輝度レベルを制御する場合、ビデオ信号処理部５１０は、電流制御回路３００からの制御信号に応じて、一点差線で示すよう

に図6の輝度最小レベルを上昇させる。このように最小輝度レベルを上昇させることは、素子発光輝度についてみると最大輝度（白）レベルを低下させることになる。これにより、通常時であればこの一点鎖線を下回る白レベル表示（図の斜線部分）は、制御信号の電圧レベルに応じて新たに設定された一点鎖線の白レベル表示に制限される。このような輝度制限処理は、例えば、デジタルビデオ信号に含まれるデジタル輝度データをアナログ変換する際に、新たに設定した高輝度側の制限範囲を超えるデータについては全て設定レベルとするなどの処理により実現できる。

【００２８】このように、制御回路３００からの制御信号に応じて図6のように最小レベル（最大輝度レベル）を制限することによっても、有機ＥＬ素子に流れる電流量を制限し、素子での消費電力を低減できる。

【００２９】なお、上記図５及び図６に示すようにコントラスト制御又は輝度レベル制御を行えば、図４の抵抗３１０による電源電圧制御効果が小さくても十分消費電力の抑制を実現することができる。また、図４の回路において、必ずしも抵抗３１０でなくてもよく、コイルなどの他の電流検出可能な素子を用い、電源電圧Vddを特に制御せず、電源回路２００から電源ラインＶＬに向かう電流量を検出する構成として制御信号を作成しても良い。

【００３０】また、以上の説明では、アクティブマトリクス型エレクトロルミネッセンス表示装置について説明したが、各画素にスイッチ素子のないパッシブ型エレクトロルミネッセンス表示装置についても同様に適用可能である。即ちＥＬ素子間に流れる電流量を電源回路とパネル電源ラインとに流れる電流量に基づいて制御することで、装置の最大消費電力を抑制することができる。また、有機ＥＬ素子に限らず、他の電流駆動型発光素子を用いた表示装置でも同様の構成とすることで、装置の最大消費電力の抑制が可能となる。

【００３１】

【発明の効果】以上説明したように、この発明においては、この電源から表示部に流れる電流量に応じて各エレクトロルミネッセンス素子などの電流駆動型発光素子に流す電流量を制御するので、表示部全体としての消費電力が所定の範囲を超えないように制御できる。また、併せて表示部において発光画素数が多い場合に、増大した電流量を抑制することで、表示が眩しくなってかえって見づらくなること防止できる。

【図面の簡単な説明】

【図１】　本発明の実施形態に係る有機ＥＬパネルの回路構成を示す図である。

【図２】　本発明の実施形態に係る有機ＥＬ素子部の概略断面構成を示す図である。

【図３】　本発明に係る有機ＥＬ表示装置の全体構成を示す図である。

【図４】　本発明の実施形態に係る電流制御回路の構成例を示す図である。

【図５】　本発明の実施形態に係るコントラスト低下制御の方法を説明する図である。

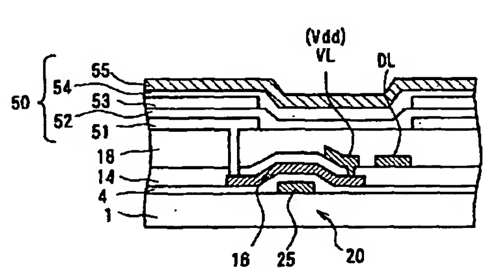
【図６】　本発明の実施形態に係る輝度低下制御の方法を説明する図である。

【図７】　従来のアクティブマトリクス型有機ＥＬ表示装置の１画素の回路構成を示す図である。

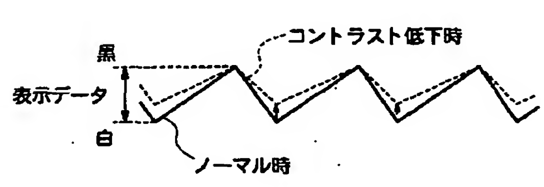
【符号の説明】

１　基板（透明基板）、４　ゲート絶縁膜、１６　能動層（ｐ－ｓｉ膜）、１０　第1ＴＦＴ（スイッチング用ＴＦＴ）、１４　層間絶縁膜、１８　平坦化絶縁層、２０　第2ＴＦＴ（素子駆動用ＴＦＴ）、２５　ゲート電極、５０　有機ＥＬ素子、５１　陽極、５２　ホール輸送層、５３　有機発光層、５４　電子輸送層、５５　陰極、１００　表示パネル、２００　電源回路、３００　電流制御回路、３１０　抵抗、３２０　制御信号発生部、３２２，３２４　第1アンプ、３２６　第2アンプ（減算回路）、３２８　第3アンプ、３３０　第4アンプ、３４０　コントロール端子、５００　表示コントローラ、５１０　ビデオ信号処理回路、ＧＬ　ゲートライン、ＶＬ　電源ライン、ＤＬ　データライン。

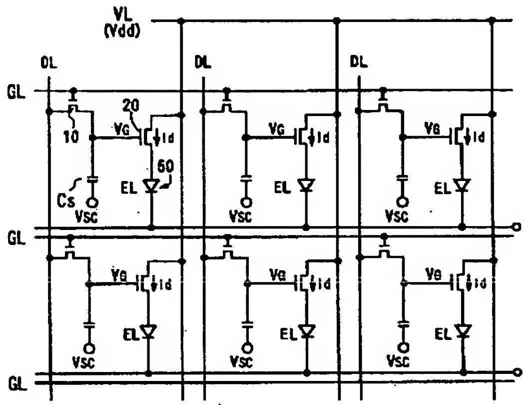
【図２】



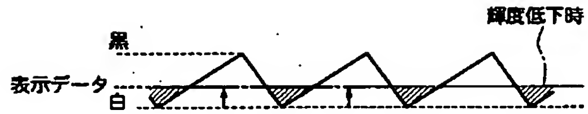
【図５】



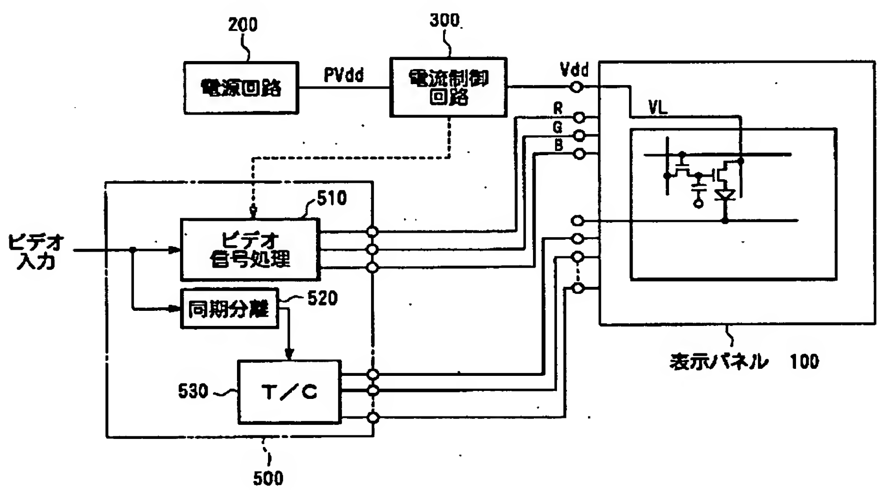
【図1】


VL
(Vdd)
DL
DL
DL
GL
GL
GL
20
10
VG
Id
60
EL
Cs
VSC

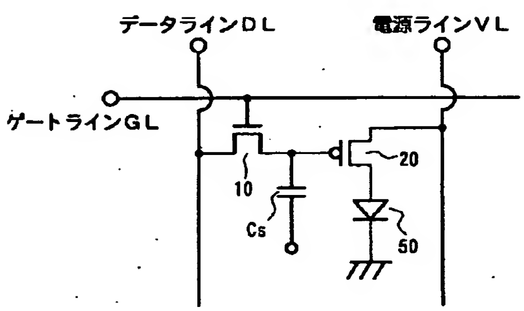
【図6】


輝度低下時
黒
表示データ
白

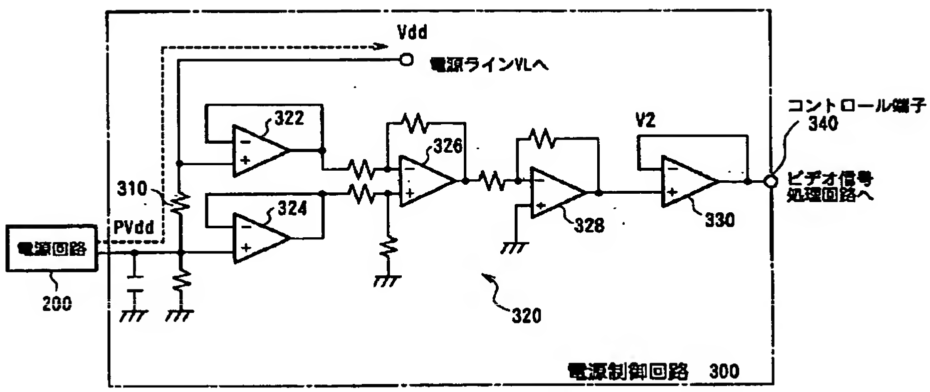
【図3】


200
300
電源回路
PVdd
電流制御回路
Vdd
VL
R
G
B
510
ビデオ入力
ビデオ信号処理
同期分離
520
530
T／C
500
表示パネル 100

【図7】


データラインDL
電源ラインVL
ゲートラインGL
10
20
Cs
50

【図4】


Vdd
電源ラインVLへ
322
324
326
328
330
V2
コントロール端子
340
ビデオ信号
処理回路へ
310
PVdd
電源回路
200
320
電源制御回路 300